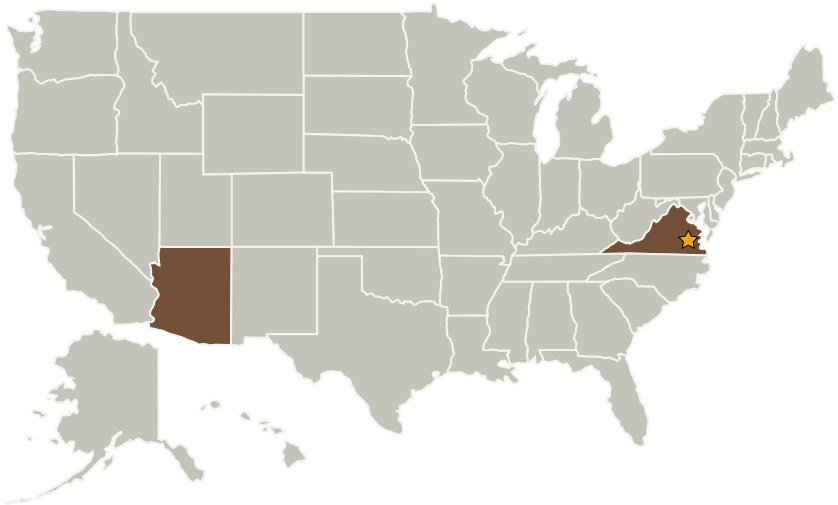
Nonlinear Aerodynamic and Nonlinear Structures Interations (NANSI) Methodology for Ballute/Inflatable Aeroelasticity in Hypersonic Atmospheric Entry, Phase II

Completed Technology Project (2009 - 2011)

Project Introduction

ZONA proposes a phase II effort to fully develop a comprehensive methodology for aeroelastic predictions of the nonlinear aerodynamic/aerothermodynamic - structure interaction (NANSI) on ballutes during hypersonic atmospheric entry, including potential surface wrinkling. A time-accurate Boltzmann aerodynamic flow solver, called BGKX, will first be extended to 3D geometries for inviscid /viscous hypersonic flows. BGKX is a robust, unified-Mach-number, all-altitude, viscous flow solver; it provides pressure and heat flux solutions in one step. To handle the complex geometry of wrinkling ballutes, an advanced cartesian grid system, called gridless boundary condition cartesian (GBCC), will be implemented within BGKX. Next, generalized reduced order models (ROM) of the BGKX aerodynamics and nonlinear structures will be established to handle ballute wrinkling and the complex flow. In addition to Direct physical coupling of the aerodynamics and structures, an aerodynamic ROM - structures ROM coupling procedure will be fully developed for efficient aeroelastic applications to wrinkled ballutes. Lastly, we will evaluate the sensitivity of the ballute aeroelastic behavior in specific structural features: the pre-tensioning of the ballute, its inflation, and the existence of structural properties variations around its circumference. ZONA will work closely with the NASA monitor in phase II should an additional ballute configuration be considered.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
ZONA Technology, Inc.	Supporting Organization	Industry Small Disadvantaged Business (SDB)	Scottsdale, Arizona

Primary U.S. Work Locations	
Arizona	Virginia

Project Transitions

February 2009: Project Start

September 2011: Closed out

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.4 Aeroacoustics